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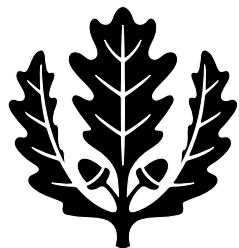
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# University of Connecticut

*Department of Economics Working Paper Series*

## **Job Matching and Wage Growth in the U.S. and Germany**

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## **Abstract**

This paper examines the contribution of job matching to wage growth in the U.S. and Germany using data drawn from the Panel Study of Income Dynamics and the German Socio-Economic Panel from 1984 through 1992. Using a symmetrical set of variables and data handling procedures, real wage growth is found to be higher in the U.S. than in Germany during this period. Also, using two different estimators, job matches are found to enhance wage growth in the U.S. and retard it in Germany. The relationship of general skills to employment in each country appears responsible for this result.

National policies for workforce education and training are designed to increase the human capital of workers and provide a labor pool well suited to the needs of industry. Increased productivity due to improved skills as well as better matches between workers and employers should lead to greater individual compensation and increased national prosperity. This paper provides an empirical examination of the contribution of job matching to rates of wage growth in two countries that pursue different national policies for workforce education and training, Germany and the United States<sup>1</sup>

The choice of these two countries for the analysis allows a contrast between relatively centralized and decentralized approaches to workforce education and training. The differences in their respective systems are well known and extensively documented (Abraham and Houseman 1993). The majority of German workers are educated, trained, and certified for employment in a specific industry. The number of educational opportunities are planned, controlled through competitive examination, and financed by the government. The majority of American workers pursue a general education. Post-secondary education is often self-financed, and demand from students plays a large role in the opportunities available. Relative to the United States, the German system is both more centralized and specific in nature.

Which system is preferable from a perspective of either overall wage growth or improved job matching is debatable. It has been argued that a relatively centralized system offers a number of advantages. When the average worker leaves school, they do not face as difficult a transition to work since they are certified for employment. Since workers have both classroom education and direct experience, they will be more

productive. As the government actively plans the number of school leavers with specific certifications, better matches between workers and firms can be achieved.

Each of these possible advantages, however, can be argued to constitute a potential disadvantage. A system that requires individuals to make occupational decisions early in life may result in poor choices due to inexperience. At times of structural shifts in employment or worker dislocation, specific industrial education may be a disadvantage for worker mobility. Moreover, government planning may lack the flexibility needed to adapt to changing market conditions.

While there are many possible impacts of a national system of education and training, this paper specifically examines the impact of job matches on rates of wage growth in the two countries. Real wage growth is consistently found to be higher in the United States than in Germany, and using two different estimation techniques, job matches are found to enhance wage growth in the U.S. while retarding it in Germany.

The paper will proceed with a review of the literature regarding the determinants of wage growth and the role of job matching in that context. A brief discussion of some of the institutional differences in the educational and training systems of Germany and the United States will also be provided. Then, initial evidence will be presented on overall returns to skills and wage growth in the U.S. and Germany in order to provide a context for considering the role of job matching. The contribution of job matching to wage growth will first be considered through an individual fixed effects model. The final section of the paper will provide an additional analysis of the portion of wage growth attributable in the two countries to job matching following the approach developed by Topel (1991).

## **I. Literature Review**

Determinants of workers' wages are fundamental to understanding labor market activity. An extensive theoretical literature provides competing explanations for observed patterns in wage rates, and an active empirical literature has confronted those theories with evidence. The vast majority of this research has focused on individual labor markets.

A common empirical pattern reported from the earliest research is the presence of a positive association of both experience and tenure with earnings (Mincer 1962).<sup>2</sup> Three major theories provide explanations for these basic empirical observations; human capital, job-matching, and efficiency wage.

According to human capital theory, workers are paid according to the value marginal product of general and specific labor market skills (Becker 1962 and Mincer 1962). General skills are transportable to other employers and specific skills are not. Since general skills are portable, firms should not pay for their financing. Jobs providing general skills should have lower starting wages and a positively sloped experience-earnings profile. Specific skills are not transportable and might be financed by the firm or the individual. If financed by the firm, one would expect the employer to pay enough to the employee to discourage movement so that the investment can be recouped. If financed by the employee, a job would be characterized by lower starting pay and a relatively more steeply sloped wage profile than in the case of firm financing or absence of training. Intermediate cases of shared investment are also possible (Hashimoto 1981; Hashimoto 2001; and Leuven and Oosterbeek 2001).

In matching models, individuals receive job offers during their lifetimes, successively accepting offers which provide a better fit between them and attributes of the firm (Burdett 1978; Jovanovic 1979; and Flinn 1986). As both greater experience and tenure are indicative of the quality of employment matches, both are expected to be positively related to wages. Thus, these models generate positively sloped wage profiles which are independent of worker skills.

In efficiency wage models, worker productivity is influenced by pay (Lazear 1981). Young workers are paid less and older workers more than their value marginal product. This scheme induces young workers to put forth effort in order to stay with a firm until they can be overpaid as an older worker. For older workers, the incentive is to work hard in order to continue being paid more than their value. In the model, wages grow independent of skill

A substantial empirical literature has sought to distinguish which factors from among these theories best explain patterns observed in returns to years of employment. Human capital theory indicates that training on the job, whether worker or firm financed, and whether general or specific, should result in upward sloping wage profiles. To estimate the relative contributions of general and specific skills in the theory, empirical researchers have typically focused on years of total work experience as a proxy for time spent gaining general labor market skills. Similarly, the duration of employment with a single employer, tenure, is used as a proxy for time potentially spent acquiring specific labor market skills. From the earliest work (Mincer 1962), the basic empirical pattern of a positive association of experience and tenure to wages has been universally reported.

The empirical observation that years of experience and tenure are each positively related to earnings is consistent with human capital theory but does not rule out other explanations. Job matching theories also predict upward sloping tenure-wage profiles, and a body of empirical work has examined the extent to which matching is responsible for this observation.

The problem encountered in estimation is that observed years of experience and tenure are related to the quality of a job match. So, estimation methods that do not take this issue into account provide biased estimates of returns to skills. Some of that research takes an econometric approach to isolating the effect of job matching relative to tenure (Flinn 1986; Altonji and Shakotko 1987; and Topel 1991). Based on those articles, one would reasonably conclude that job matching plays some role in generating observed returns to skills although estimates of the exact contribution vary.

In order to move away from econometric restrictions in attempts to identify the effect of matching on returns to tenure, a more recent literature has exploited longitudinal data from job displacements (Kletzer 1989; Ruhm 1991; and Neal 1995). The argument behind these papers is that permanent job loss is an exogenous event uncontrolled by individual workers. Comparing earnings before and after the event of an exogenously imposed job loss should reveal the extent to which returns to tenure are associated with factors related to that specific job match. Each of these papers (Kletzer 1989; Ruhm 1991; and Neal 1995) reports evidence that that a portion of returns to skills are due to the quality of job matches.<sup>3</sup>

Efficiency wage theories also generate positively sloped wage profiles. One testable implication of the theory is that these profiles should be more flatly sloped in



segments of the labor market where agency problems are not as large (Lazear and Moore 1986). Also, since earnings will increase in the absence of productivity gains, returns to tenure will occur in firms with no training. Levine (1993) finds that firms that provided more training did not exhibit larger returns to tenure. Other researchers have investigated whether pay is linked with firm measures of worker productivity such as job evaluations and have found that the link is weak (Medoff and Abraham 1980 and 1981). Thus, there is also empirical support for the view that firms use considerations beyond productivity in their wage setting process.

The most recent research in this area has used information on both firms and their workers to investigate alternative theories of wage determination in a more integrated framework (Abowd, Kramarz, and Margolis 1999 and Abowd, Kramarz, Margolis, and Troske 2001). Their research demonstrates that all of the previously theorized influences do play a role in wage determination. Based on their results, it would also appear that individual effects are more important than firm effects in explaining the variation in wage rates.

In summary, these theoretical and empirical literatures have advanced together in attempting to explain which factors in the labor market lead to positively sloped earnings profiles. At this point, most would agree that the market rewards general and specific skills and that observed returns additionally reflect both the quality of the job match as well as attempts of firms to raise productivity through the structure of compensation.

As our understanding of wage determinants has solidified, a literature which makes comparisons across countries has begun to develop. The goal of these papers is to see how similar the factors are which determine wages in different countries and how

institutions may affect their importance in different societies (Abowd, Kramarz, Margolis, and Troske 2001, Hashimoto and Raisian 1985 and Levine 1993). Each of these international comparisons has been limited to some extent in the topics that could be examined due to the need to have comparable data across countries for the analysis.

The work of Hashimoto and Raisian (1985) was motivated by the superior economic performance of Japan relative to the United States in the 1970s and 1980s and the observation that the Japanese labor market appeared to be characterized by longer attachments between firms and employees. Using nationally representative data, they found that returns to additional years of employment are higher and peak later in Japan than in the U.S. From this, they concluded that Japanese workers had a stronger incentive to remain with one employer, and this was reflected in lower rates of turnover and higher years of tenure in the Japanese labor market.

Levine (1993) used samples of matched firms and workers in Japan and the United States to critically examine whether human capital theory was consistent with the positively sloped employment-earnings profiles in the two countries. Focusing primarily on whether firms that provide more training have steeper tenure-wage profiles and whether firms with higher returns to tenure have lower turnover, Levine presented evidence against both of these hypotheses. He concludes that human capital theory is not consistent with the evidence presented and suggests that efficiency wage theory provides a better explanation of wage setting in the two countries.

Abowd, Kramarz, Margolis, and Troske (2001) compare the U.S. and France using matched individual and firm level data. They examine the impact of firm and individual characteristics on wage determination and other outcomes. They find that

standard human capital variables earn positive returns in the labor market and that unobserved individual and firm attributes impact wages. Another particularly interesting finding of their study is that higher wages are related to greater productivity in both U.S. and French firms.

This paper similarly provides a comparative examination of wage rate determination. The primary focus of the research is to obtain evidence regarding the contribution of job matching to wage growth in the United States and Germany.

## **II. Institutional Differences**

A detailed examination of all of the institutional differences between Germany and the United States that impact on this analysis would be out of place in a paper that seeks to examine an outcome associated with a broad approach rather than a specific aspect of policy. Nonetheless, some brief information which characterizes the major differences will be presented here. An excellent, detailed comparison of educational and labor market institutions in the two countries can be found in Abraham and Houseman (1993).

German secondary education has two main tracks, vocational training and college preparatory. Determination of tracking is made by competitive examination. The majority of German secondary students participate in the vocational track which is usually referred to as the dual system of education. The term dual refers to classes students take about the industry in which they will work and the practical training they simultaneously receive through an apprenticeship at a relevant firm. Upon completion, the Germans are formally certified to work in an industry. This track of education is

taken by more than 80 percent of German secondary students (Couch 1994; Winkelmann 1996).

Little formal certification exists for high school students in the United States. Based on student self-assessments, vocational degrees are received by about 30 percent of secondary students. At the secondary level, education in the U.S. is clearly more general in its content than in Germany.

At the post-secondary level, there are other contrasts. University education is government financed in Germany, and there are few opportunities for those who would like to self-finance education beyond what their placement scores have merited. 14 percent of Germans hold a university degree. In the United States, ability to pay plays a much larger role in educational access at the post-secondary level. A policy of loans and grants has arisen to reduce this concern. Whether through private resources or public assistance, more opportunities for risk taking exist when individuals perceive post-secondary education is a good investment. As a result, 27 percent of the labor force in the United States holds a university degree.

While one can make a priori arguments that one or another system is superior, the German education and job training approach is clearly more centralized than that of the U.S. Here, the intention is to investigate how these broad policy approaches affect wage growth and job matches in the two countries.

## **II. Returns to Skills and Wage Growth in Germany and the United States**

Job matching is theoretically expected to be a component of overall wage growth. In standard models, wage growth can be seen through the combined rates of return to experience and tenure. To provide initial estimates of returns to skills for Germany and

the United States, panel regressions of log wages on standard explanatory variables are estimated using data from the Panel Study of Income Dynamics (PSID) for the United States and from the German Socio-Economic Panel (GSOEP) for Germany for the years from 1984 through 1992. Male workers ages 18 to 60 are included in the sample.

Additional selection criteria are that the worker must be employed 1000 hours in the year and must report annual earnings of 1000 Deutsche Marks or the U.S. equivalent. Self-employed and government workers are excluded. This sample is used as the basis of all of the analyses presented in the paper. There are 10,110 observations from the PSID and 8,281 from the GSOEP. Unless noted otherwise, estimates presented in the paper are weighted to account for the longitudinal nature of the data.

For the variables used to decompose the employment experience of a typical worker into proxies for their general and specific skills, conventions in the literature regarding their measurement are followed. In both data sets, retrospective information on years of full-time employment experience is used to calculate years of total labor market experience. This variable is considered a proxy for general labor market skills. Also, information regarding years of employment with a specific employer is used to calculate years of tenure for the workers in each country. This variable is considered a proxy for specific skills.

In handling each of the variables used in the analysis, identical selection criteria were used both in extracting the observations and in any recoding which was performed. Perhaps the one variable which is deserving of some comment is tenure as the noise in that variable is well known (Topel 1991). One initial comment to make is that relative to prior studies using the PSID data, the questions asked regarding employment duration

stopped using bracketed responses and began referring to actual time spans prior to the date at which the sample here is drawn. While this may have alleviated some problems regarding noise in the sample, unrealistic patterns in the tenure information were observed. Thus, some recoding of the data was performed similar to that reported by Topel. The general effect of this cleaning on the data was to increase the estimated returns to experience and tenure in both the United States and Germany. None of the qualitative conclusions were altered. Appendix A1 contains a description of the recoding, patterns of tenure in the two countries, and a comparison of the tenure variable from the PSID against a published source.

Other regressors included in the analysis are marital status, years of schooling, and a set of categorical time dummies. The dependent variable is the natural log of average hourly wages calculated as annual labor earnings divided by annual work hours. The wages are measured as real 1984 figures. Unweighted means and standard deviations of the pooled sample of observations from each country are reported in table 1. Comparable weighted estimates are contained in appendix table 2.<sup>4</sup>

The equation estimated can be written as:

$$Y_{ijt} = \alpha + \beta_1 X_{ijt} + \beta_2 T_{ijt} + \varepsilon_{ijt} \quad (1.)$$

Y refers to the log of average hourly wages. The subscript i refers to individuals, j to employers, and t to time periods.. X represents years of full-time job experience. T represents years of tenure with an employer.  $\varepsilon$  is measurement error.

In addition to the means and standard deviations of the variables, table 1 contains unweighted parameter estimates from the panel regressions for Germany and the United States. The terms for experience and tenure are represented as quartics. Based on those

estimates, in the U.S., the estimated return to a year of experience is 6.3 percent and for an additional year of employment tenure is 4.4 percent. This yields a combined 10.7 percent average rate of wage growth over the period examined. For Germany, the returns to both experience and tenure are much lower than in the United States. Returns to years of experience are 3.1 percent and 1.3 percent for a year of tenure yielding a combined 4.4 percent annual increase in wages. By reference to the estimates contained in appendix table 2, it can be seen that weighting has a relatively small impact on the parameter estimates.

In general, the returns to both experience and tenure in Germany and the United States have the expected shape. This can be seen by the alternating signs of the parameter estimates associated with the higher order terms for tenure and experience in each country. All of the relevant parameter estimates are statistically significant at the .05 level.

#### **IV. Fixed Effect Estimates**

In matching theory, individuals search for jobs where their own characteristics align with the needs of an employer. Good outcomes are more durable, and years of observed experience and tenure reflect the quality of a job match. One method of investigating the contribution of job matches to wage growth is to model that component as an individual fixed effect.

The fixed effect estimation equation rewrites the error term to consist of a time invariant component related to individuals along with a fixed component for each time period. The equation for individuals can be written as:

$$Y_{ijt} = \alpha + \beta_1 X_{ijt} + \beta_2 T_{ijt} + \phi_i + \gamma_t + \zeta_{ijt}$$

$\Phi_i$  represents the individual fixed effect.  $\gamma_t$  represents the fixed time component.  $\xi$  is the random error component.

Table 1 contains unweighted results for the fixed effect models estimated for the U.S. and Germany. Because the panel regressions contained in table 1 included dummy variables for the years from which the data were drawn and a common set of control variables, the impact of the individual fixed effects can be seen by the change in the parameter estimates across the two tables. Interestingly, as individual fixed effects are controlled for in the United States, the estimates of both the returns to experience and tenure fall. One interpretation of this result is that gross returns to labor market skills are inflated by the average quality of employment matches. In Germany, the opposite result is found. Relative to the panel regression estimates in table 1, the returns to experience and tenure rise when the individual fixed effects are included. One interpretation is the average quality of job matches depresses observed wage growth.

## **V. Residual Correlation Model**

Examining the possibility that the quality of job matches are reflected in individual fixed effects tells us something about the portion of wage growth that might be attributed to job matching. An alternative method of modeling the relationship between observed labor market activity and the unobserved quality of a job match was developed by Topel (1991). The method provides estimates of total wage growth as well as the component attributable to job matching. The model of Topel (1991) begins with a standard log wage equation (1.) in the form of the one presented earlier in the paper.<sup>5</sup>



Potential biases exist in obtaining estimates of the returns to general and specific skills from least squares estimates of equation (1.) since either may be correlated with the error term,  $\varepsilon_{ijt}$ . This can be made more explicit by rewriting the residual as

$$\varepsilon_{ijt} = \phi_{ijt} + \mu_i + \nu_{ijt}$$

$\mu_i$  represents an individual fixed effect.  $\phi_{ijt}$  represents factors specific to the match between a job and individual.  $\nu_{ijt}$  is random error. The factors specific to a job match may be nonorthogonal to tenure and experience. Represent this relationship as

$$\phi_{ijt} = X_{ijt}b_1 + T_{ijt}b_2 + \eta_{ijt}$$

This system of equations together yields the conclusion that least square estimates of  $\beta_1$  and  $\beta_2$  will be consistent but biased; i.e.,

$$E(\hat{\beta}_1) = \beta_1 + b_1$$

and

$$E(\hat{\beta}_2) = \beta_2 + b_2$$

From (1.), a two-step estimation procedure is formed by first estimating a differenced earnings equation. This eliminates fixed job and individual effects. The equation to be estimated is

$$Y_{ijt} - Y_{ijt-1} = \beta_1 + \beta_2 + \varepsilon_{ijt} - \varepsilon_{ijt-1} \quad (2.)$$

Least squares of (2.) will provide an estimate of total wage growth.

The second stage of the estimation procedure removes the portion of growth due to years of tenure from observed earnings then estimates the returns to experience at the time the job started.

$$Y_{ijt} - T_{ijt}\hat{\beta} = X_0\beta_1 + \varepsilon_{ijt} \quad (3.)$$

Here,  $\hat{\beta}$  represents the estimates of parameters associated with wage growth from the first step.  $X_0$  represents experience at the time the current job started. By this procedure, an estimate of the returns to seniority is obtained as  $\hat{\beta}_2 = (\hat{\beta}_1 + \hat{\beta}_2) - \hat{\beta}_1$ . When least squares is applied to this system of equations, the resulting estimates are consistent but biased.

$$E(\hat{\beta}_1) = \beta_1 + b_1 + \gamma_{X_0T}(b_1 + b_2) \quad (4a.)$$

and

$$E(\hat{\beta}_2) = \beta_2 - b_1 + \gamma_{X_0T}(b_1 + b_2) \quad (4b.)$$

Although these estimates are biased, they provide an upper bound on the estimated return to general skills and a lower bound on the return to specific skills.  $\gamma_{X_0T}$  is the coefficient from an auxiliary regression of tenure on initial experience. An empirical estimate of  $(b_1 + b_2)$  can be obtained by reinserting  $T_{ijt}$  into the right hand side of equation (3.) since  $\phi_{ijt}$  can be rewritten as  $X_0b_1 + T_{ijt}(b_1 + b_2) + \eta_{ijt}$ . Thus, one can also obtain an inference about a portion of the bias in equation (4.),  $\gamma_{X_0T}(b_1 + b_2)$ .

Table 2 shows the results of the estimation of equation (2.) by least squares. The change in experience variable is omitted because it would be collinear with the change in tenure variable. The parameter associated with  $\Delta Tenure$  thus estimates  $\beta_1 + \beta_2$ ; i.e., the overall rate of wage growth. Across the three columns of the table, various combinations of higher order terms are presented to demonstrate the relative stability of the parameter

estimate associated with  $\Delta$ Tenure. Across all of the estimates, the higher order terms take the expected signs. Statistical significance at the .05 level is denoted in the table.

Comparing the results shown here for the United States to those obtained by Topel (table 2, p. 157) using PSID data spanning the period from 1968 through 1983, they are very similar. For example, in the quartic specification in column (3.), the estimated magnitude of  $\beta_1 + \beta_2$  in Topel's work is .126 which is the same as the value reported here in table 3. While this result is certainly not expected, it does suggest that wage growth has not changed appreciably across these two time periods.

The estimates for wage growth in Germany based on equation (2.) which are shown in table 2 indicate that the combined returns to a year of experience and employment tenure are smaller than in the United States. Table 3 provides the second step estimates from equation (3.) of the experience parameter,  $\beta_1$ . By subtracting  $\beta_1$  from  $\beta_1 + \beta_2$ , an estimate is obtained for  $\beta_2$ . In order to provide standard errors for  $\beta_1$  and  $\beta_2$  that are reflective of the two stage estimation procedure, the calculation process was bootstrapped for 100 iterations, sampling the individuals in the sample with replacement. The standard errors shown in table 3 result from the bootstrapping procedure. Statistical significance at the .05 level is denoted in the table.

The parameter estimates for the U.S. are very similar to those reported by Topel (table 3, p.158). He reports the return to experience to be .071 and .055 for the return to tenure. Here, the return to experience is .085 and the return to tenure is .041. The return to experience, .034, is smaller in Germany than for the U.S. The estimated return to tenure in Germany, .064, is larger than in the U.S.

The estimate of the bias term,  $(b_1 + b_2)$ , is obtained by inserting the tenure variable on the right hand side of equation (3.) and applying least squares. The estimates are shown in the last column and reflect the impact job matching would be expected to have on least squares estimates. The standard errors reported in the table are also bootstrapped to reflect the two stage estimation procedure. The estimate is positive for the U.S. and negative for Germany. The interpretation is that unobservables related to job match quality would lead to an overstatement of skill related wage growth in the United States and an understatement in Germany using least squares. Stated differently, average job match quality has led to an increased rate of wage growth in the U.S. but has reduced it in Germany.

The signs of these job match components are consistent with the estimates obtained using the fixed-effects estimator. Prior research suggests that the negative sign from each of these estimators for Germany is plausible. For example, Abowd, Karmarz, and Margolis (Table IV) also report impacts of firm matching on returns to tenure in France which range from 0 to -.036 depending on the estimator employed. They also demonstrate that controlling for person fixed effects raises the estimated return to experience in France. In general, this is the same pattern found here for Germany.<sup>6</sup>

The estimate of bias in total wage growth provided by  $(b_1 + b_2)$  can also be inserted into equation (4.) to gauge a portion of the bias that unobservables have on either the estimated return to experience or tenure. This requires that an additional parameter,  $\gamma_{X_0T}$ , be estimated from an auxiliary regression of tenure on initial experience. That parameter for the U.S. is -.064 and -.160 for Germany. Calculated as  $\gamma_{X_0T}(b_1 + b_2)$ , the portion of the bias due to this component in each country is negligible, -.002 in the U.S.

and .004 in Germany. Considering equation (4.), the implication is that in both countries the bias in estimating rates of return operates principally through the correlation of general skills with job matches.

## **VI. Conclusion**

This paper provides an analysis of the contribution of job matching to wage growth in Germany and the United States. The estimated rate of real wage growth in the U.S. is consistently found to be higher than in Germany. This result is obtained both in panel regressions (table 1) and in a differenced estimator (table 2).

Real rates of wage growth, however, depend on many policies beyond those directly aimed at the labor market. While job matches also depend on factors beyond a nation's approach to workforce education and training, those policies are directly intended to provide better employment matches between workers and firms. Moreover, accepted theory suggests that one component of wage growth is due to job matching.

In the analysis presented here, job matches are found to promote overall wage growth in the U.S. In Germany, job matches are found to retard overall wage growth. This result is consistent across both a fixed effect estimator (table 1) and a two step procedure (tables 2 and 3) developed by Topel (1991). Also, using the two-step estimator, evidence is found in both countries that the impact of job matching on wage growth operates primarily through the relationship of general skills to employment.

Education and training policies have many other aims beyond promoting wage growth or improvement of employment matches. Also, empirical results such as these are appropriately seen as robust when replicated in other research. Nonetheless, the results reported here for the effect of job matching on wage growth are potentially very

interesting because they suggest that some of the common complaints about relatively centralized and specific systems of education and training may be true.

Having youths choose occupations relatively early may result in poor individual choices that are difficult to correct. Focusing on specific skills may reduce chances for mobility. Planning may not be flexible enough in the face of structural changes in the economy. The research contained in this paper does not address each of these individual topics but does suggest avenues for future research.

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**Table 1**  
**Unweighted Estimates of Returns to Skills in the United States and Germany**  
**1984-1992**

	Means and Standard Deviations		Panel Regressions		Fixed Effect Model	
	United States	Germany	United States	Germany	United States	Germany
<b>Regressors:</b>						
<b>Experience</b>	<b>12.05</b> (8.17)	<b>18.72</b> (11.42)	<b>.063</b> (.005)*	<b>.031</b> (.002)*	<b>.044</b> (.007)*	<b>.041</b> (.003)*
<b>Experience<sup>2</sup>/(10<sup>2</sup>)</b>	<b>2.12</b> (2.66)	<b>4.81</b> (4.63)	<b>-.561</b> (.063)*	<b>-.218</b> (.022)*	<b>-.383</b> (.081)*	<b>-.199</b> (.028)*
<b>Experience<sup>3</sup>/(10<sup>3</sup>)</b>	<b>4.65</b> (8.13)	<b>14.11</b> (17.62)	<b>.214</b> (.029)*	<b>.063</b> (.008)*	<b>.132</b> (.037)*	<b>.056</b> (.010)*
<b>Experience<sup>4</sup>/(10<sup>4</sup>)</b>	<b>11.58</b> (25.08)	<b>44.59</b> (67.25)	<b>-.028</b> (.004)*	<b>-.006</b> (.001)*	<b>-.016</b> (.006)*	<b>-.006</b> (.001)*
<b>Tenure</b>	<b>9.04</b> (8.41)	<b>10.80</b> (8.67)	<b>.044</b> (.004)*	<b>.013</b> (.002)*	<b>.018</b> (.004)*	<b>.017</b> (.002)*
<b>Tenure<sup>2</sup>/(10<sup>2</sup>)</b>	<b>1.52</b> (2.58)	<b>1.92</b> (2.62)	<b>-.255</b> (.049)*	<b>-.094</b> (.023)*	<b>-.136</b> (.049)*	<b>-.164</b> (.026)*
<b>Tenure<sup>3</sup>/(10<sup>3</sup>)</b>	<b>3.44</b> (8.17)	<b>4.21</b> (8.19)	<b>.068</b> (.021)*	<b>.034</b> (.010)*	<b>.044</b> (.022)*	<b>.055</b> (.012)*
<b>Tenure<sup>4</sup>/(10<sup>4</sup>)</b>	<b>8.99</b> (27.46)	<b>10.54</b> (27.16)	<b>-.007</b> (.003)*	<b>-.004</b> (.001)*	<b>-.005</b> (.003)*	<b>-.006</b> (.002)*
<b>Years of School</b>	<b>13.23</b> (2.35)	<b>11.45</b> (2.58)	<b>.052</b> (.001)*	<b>.019</b> (.001)*	<b>.002</b> (.009)	<b>.037</b> (.005)*
<b>Marital Status</b>	<b>.75</b> (.44)	<b>.74</b> (.44)	<b>.059</b> (.006)*	<b>.031</b> (.004)*	<b>.011</b> (.008)*	<b>.014</b> (.006)*
<b>Log Wages</b>	<b>.93 (.28)</b>	<b>1.11 (.15)</b>	-----	-----	-----	-----
<b>R-Squared</b>	-----	-----	<b>.33</b>	<b>.27</b>	<b>.15</b>	<b>.16</b>
<b>N</b>	<b>10,110</b>	<b>8,281</b>	<b>10,110</b>	<b>8,281</b>	<b>10,110</b>	<b>8,281</b>

Source: The estimates presented in the table are weighted and based on calculations by the author using data drawn from the 1984 through 1992 years of the PSID and GSOEP. A full description of the sample is contained in the text. The estimates are weighted to reflect the longitudinal nature of the data. Entries in the columns for mean and standard deviation take the form: mean (standard deviation). Entries in the other columns take the form: parameter (standard error). See Appendix table 2 for unweighted estimates. \* denotes statistical significance at the .05 level.

Table 2

**Estimates of Equation (2.)**  
**Model of Annual Within-Job Wage Growth**  
**PSID and GSOEP Males 1984-1992**  
**Dependent Variable is Change in Log Real Wage**

		<b>United States</b>		
<b>Variable</b>		(1.)	(2.)	(3.)
Tenure		.117 (.016)*	.118 (.016)*	.126 (.018)*
Tenure <sup>2</sup> /(10 <sup>2</sup> )			-.069 (.022)*	-.306 (.148)*
Tenure <sup>3</sup> /(10 <sup>3</sup> )				.068 (.064)
Tenure <sup>4</sup> /(10 <sup>4</sup> )				-.004 (.008)
Experience <sup>2</sup> /(10 <sup>2</sup> )		-.735 (.168)*	-.673 (.169)*	-.540 (.175)*
Experience <sup>3</sup> /(10 <sup>3</sup> )		.193 (.065)*	.187 (.065)	.141 (.067)*
Experience <sup>4</sup> /(10 <sup>4</sup> )		-.018 (.008)*	-.018 (.008)	-.013 (.008)
R-Squared		.012	.014	.016
		<b>Germany</b>		
Tenure		.079 (.014)*	.081 (.014)*	.098 (.015)*
Tenure <sup>2</sup> /(10 <sup>2</sup> )			-.034 (.022)	-.523 (.129)*
Tenure <sup>3</sup> /(10 <sup>3</sup> )				.228 (.057)*
Tenure <sup>4</sup> /(10 <sup>4</sup> )				-.031 (.008)*
Experience <sup>2</sup> /(10 <sup>2</sup> )		-.291 (.137)*	-.279 (.137)*	-.149 (.142)
Experience <sup>3</sup> /(10 <sup>3</sup> )		.080 (.048)	.081 (.048)	.038 (.049)
Experience <sup>4</sup> /(10 <sup>4</sup> )		-.008 (.005)	-.009 (.005)	-.004 (.006)
R-Squared		.010	.010	.010

Note: Table entries take the form: parameter (standard error). The estimates are weighted. \* denotes statistical significance at the .05 level.

**Table 3**  
**Second Step Estimates**  
**Effects of Experience ( $\beta_1$ ) and Tenure ( $\beta_2$ ) on Log Real Wages**  
**and Least-Squares Bias in Wage Growth ( $b_1 + b_2$ )**

		Wage Growth $\beta_1 + \beta_2$	Experience $\beta_1$	Tenure $\beta_2$	Growth Bias $b_1 + b_2$
United States		.126 (.009)*	.085 (.010)*	.041 (.009)*	0.032 (.007)*
Germany		.098 (.009)*	.034 (.009)*	.064 (.004)*	-0.022 (.006)*

Note: Table entries for model estimates take the form: parameter (standard error). Other variables included in the model estimates are years of education and marital status. \* denotes statistical significance at the .05 level.

## **Appendix A**

### **Employment Tenure in the U.S. and Germany**

Direct data regarding years of employment tenure are relatively rare and form a key variable for the analysis presented in this paper. Beyond a description of the recoding of the tenure information, this appendix contains a table of basic patterns of employment tenure across Germany and the U.S. and a comparison of the U.S. figures to published data.

The specific cleaning done to the tenure variable in both countries was to examine cases where across years of continuous employment, the tenure variable made discontinuous jumps. The illogical jumps were recoded to be consistent with adjoining observations. Also, where years of experience or tenure were simply infeasible given the age of the individual, they were dropped from the sample.

Appendix table 1 contains information regarding years of employment tenure for various age groupings in Germany and the United States. The figures reported in the table are calculated using the samples from the PSID and GSOEP for male workers described in the body of the paper.

Among male workers ages 18 to 60, median employment tenure in Germany is seven years versus four for the United States. Tenure is low in both countries in the early stages of labor market activity as would be expected. By mid-life, German workers remain longer with their employers. Among male workers ages 35-44, median tenure in Germany is ten years as opposed to seven in the U.S. In later years of working activity in the United States, median tenure declines. As a result, in the oldest age range examined, median tenure is 16 years in Germany versus 8 in the U.S. The attachment of workers to

employers is more durable in Germany than in the United States, particularly as workers become older.

A brief examination of the tails of the distribution of years of tenure supports this conclusion. Among all male workers in the United States, 70 percent have less than 10 years of tenure and 19 percent have more than 15 years. In Germany, 58 percent have less than 10 years of tenure while 27 percent have more than 15 years. In Germany relative to the United States, fewer workers have short durations with their employer and more have longer durations. This pattern is driven by older workers in Germany being characterized by having longer durations of employment than are observed in the United States.

It would be helpful to know if the numbers calculated here agree with other sources of information. While a comparative source of data is not available for Germany, the numbers shown in table A1 for the United States accord well with official statistics. For example, the *Statistical Abstract of the United States* reports that in 1998, median years of tenure for workers ages 16 and over is 3.7 years and is 4.0 years for workers ages 20 and over. Here, years of tenure for a sample ages 18 to 60 are calculated to be 4.0 years. Perhaps of greater concern for the United States data is the rising pattern for years of tenure that declines at later ages. In the Statistical Abstract, the same pattern is observed. Although the numbers calculated here are from panel data and the official statistics are based on cross-sectional data with a larger sample, the figures are nonetheless close in their levels and exhibit similar patterns in the movement of years of tenure with age.

**Appendix Table 1**  
**Distribution of Male Population by Age and Tenure**  
**1984-1992**

		<b>United States</b>			<b>Germany</b>		
<b>Age</b>		Median Tenure	Less Than 10 Years	More Than 15 Years	Median Tenure	Less Than 10 Years	More Than 15 Years
18-19		1.0	100.0	0.0	0.0	100.0	0.0
20-24		2.0	100.0	0.0	1.0	100.0	0.0
25-34		3.0	86.0	3.0	4.0	84.0	3.0
35-44		7.0	59.0	25.0	10.0	48.0	28.0
45-49		11.0	48.0	41.0	14.0	33.0	48.0
50-60		8.0	53.0	39.0	16.0	34.0	53.0
All Ages		4.0	70.0	19.0	7.0	58.0	27.0

Source: The numbers reported in the table were calculated by the author using data from the Panel Study of Income Dynamics for the United States and the German Socio-Economic Panel for Germany. Data from both surveys were drawn from the panel years from 1984 through 1992 and are weighted to account for their longitudinal nature. Other than the median tenure figures reported, the other table entries are percentages.

**Appendix Table 2**  
**Weighted Regressions of Male Wages for Germany and the United States**  
**1984-1992**

	Means and Standard Deviations		Regressions	
	United States	Germany	United States	Germany
Regressors:				
Experience	11.44 (8.10)	19.21 (11.42)	.069 (.005)*	.029 (.002)*
Experience <sup>2</sup> /(10 <sup>2</sup> )	1.96 (2.59)	4.99 (4.67)	-.601 (.057)*	-.205 (.022)*
Experience <sup>3</sup> /(10 <sup>3</sup> )	4.26 (7.86)	14.73 (17.88)	.220 (.026)*	.059 (.008)*
Experience <sup>4</sup> /(10 <sup>4</sup> )	10.57 (24.11)	46.74 (68.53)	-.028 (.004)*	-.006 (.001)*
Tenure	8.59 (8.12)	11.04 (8.73)	.038 (.004)*	.013 (.002)*
Tenure <sup>2</sup> /(10 <sup>2</sup> )	1.40 (2.44)	1.98 (2.66)	-.216 (.044)*	-.105 (.023)*
Tenure <sup>3</sup> /(10 <sup>3</sup> )	3.08 (7.68)	4.38 (8.39)	.058 (.018)*	.039 (.010)*
Tenure <sup>4</sup> /(10 <sup>4</sup> )	7.93 (25.72)	11.02 (27.9)	-.006 (.003)*	-.005 (.001)*
Years of School	12.76 (2.44)	11.46 (2.52)	.048 (.001)*	.018 (.001)*
Marital Status	.71 (.45)	.75 (.43)	.046 (.006)*	.030 (.004)*
Log Wages	.87 (.31)	1.10 (.154)	-----	-----
R-Squared	-----	-----	.34	.26
N	10,110	8,281	10,110	8,281

Source: The estimates presented in the table are based on calculations by the author using data drawn from the 1984 through 1992 years of the PSID and GSOEP. A full description of the sample is contained in the text. The estimates are weighted to reflect the longitudinal nature of the data. Entries in the columns for mean and standard deviation take the form: mean(standard deviation). Entries in the columns for the regressions take the form: parameter(standard error). \* denotes statistical significance at the .05 level.



## Endnotes

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<sup>1</sup> The data used in the analysis span the years 1984-1992. In order to avoid problems associated with reunification, only the former West Germany is considered in the analysis.

<sup>2</sup> Earnings in this literature often refers to a periodic rate of pay. For the remainder of the paper, the terms earnings and wages will be used interchangeably although the paper analytically considers wages.

<sup>3</sup> The literature on displacement in Germany is more recent and has yet to consider this topic (Burda and Mertens 2001; Couch 2001; and Pfann and Hamermesh 2001).

<sup>4</sup> All of the figures presented in table 1 are unweighted. The estimator for the fixed effect model would not accept weights so a decision was made to have all calculations in the table remain unweighted to facilitate a comparison to the panel regression estimates. Weighted values for the means and the panel regressions are found in appendix table 2. By comparison, the reader can see that the weighting had relatively impact on the calculations.

<sup>5</sup> The notation follows that of Topel. More detail may be found in his paper.

<sup>6</sup> The only dissimilarity in the finding reported in table 3 relative to those of Topel (1991) and others who have used this estimation technique (Jacobsen and Levin, 2002) is the magnitude of the estimated job matching bias. Discussions with Jacobsen and detailed examinations of the estimation programs have not uncovered a source of this difference.